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(71)Applicant : TAMA TLO KK

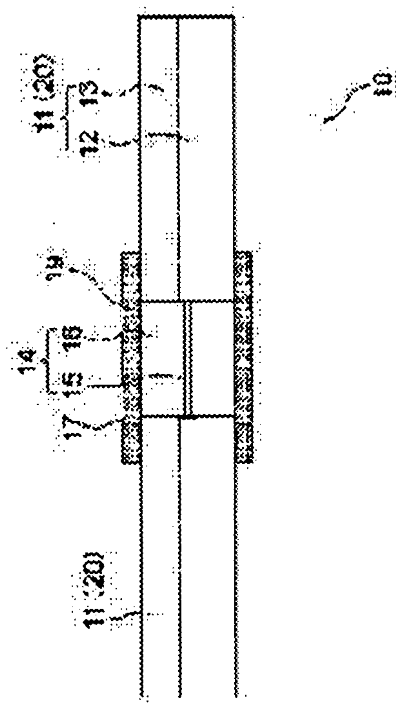
(72)Inventor : WATANABE KAZUHIRO
SEKI ATSUSHI
IGA MITSUHIRO
KUBOTA YUZURU

(54) REFRACTIVE INDEX SENSOR, SENSOR SYSTEM AND OPTICAL FIBER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a refractive index sensor which has a simple structure, is simply manufactured and can easily and accurately measure a refractive index of a desired sample.

SOLUTION: When a light transmitted in an optical fiber 11 enters into a hetero core 14 of a plasmon resonance sensor 10, a sufficient quantity of the light extends in a clad 16 and the light is reflected by an outer interface 19 of the fiber in the clad 16 in a cladding mode. Since a metal thin film 17 is formed on the outer interface 19 of the clad, a surface plasmon phenomenon is excited, a light entering at the predetermined incident angle influenced by an atmosphere on a surface of the metal thin film 17 and depending on a characteristic of the sample is used for excitation of the surface plasmon phenomenon, and light intensity is reduced. The refractive index of the sample is found by finding degree of a loss at a wavelength of a propagated light in a spectral analyzer 40.



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(71)出願人　800000080
タマティーエルオー株式会社
東京都八王子市旭町9番1号　八王子スクエアビル11階

(72)発明者　渡辺　一弘
東京都八王子市丹木町1－236　創価大学内

(72)発明者　関　篤志
東京都八王子市丹木町1－236　創価大学内

(74)代理人　100094053
弁理士　佐藤　隆久

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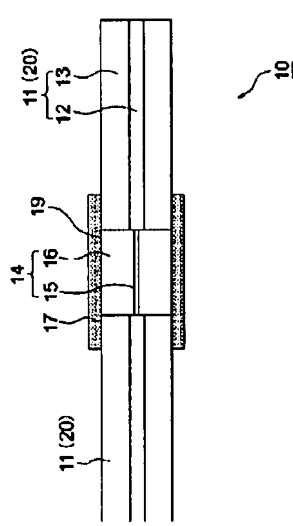
(54)【発明の名称】　屈折率センサー、センサーシステムおよび光ファイバ

(57)【要約】
【課題】簡単な構成で製造が簡単で、所望の試料の屈折率を容易かつ正確に測定することのできる屈折率センサーを提供する。
【解決手段】光ファイバ11内を伝送された光がプラズモン共鳴センサー10のヘテロ・コア部14に入射されると、相当の量がクラッド部16に広がり、クラッド部16ではクラッディングモードとしてファイバの外境界面19で光の反射が行われるようになる。クラッド外境界面19には金属薄膜17が形成されているため、これにより表面プラズモン現象が励起され、金属薄膜17の表面の雰囲気に影響された、試料の特性に依存した所定の入射角の光が表面プラズモン現象の励起に使われ、光の強度が減少される。スペクトルアナライザ40において、伝播された光の波長に対する損失の度合を求めることにより、試料の屈折率を求めることができる。



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical fiber which has the sensor system which can detect easily physical quantity, the amount of chemistry, or a phenomenon of the arbitration in connection with a desired sample etc., and such the refractive-index sensor section using the refractive-index sensor which can detect the refractive index of a desired sample easily, and its refractive-index sensor.
[0002]
[Description of the Prior Art] In recent years, a surface plasmon phenomenon is used and the so-called biosensor which measures protein concentration etc. is put in practical use. First, this surface plasmon phenomenon is explained with reference to drawing 6 . When the light in glass carries out total reflection in an interface with the exterior, the transmitted wave arises near [which is called evanescent wave in the interface] the front face. And it exists only in a front face, and since [which disappears as it goes outside] the wave has oozed out from the front face, this is called EBANESSENTO (Evanescent: carry out and disappear to **). If a metal thin film exists in the exterior and the interface of glass at this time, the electron in a metal will be excited by the evanescent wave and the surface wave of the surface plasmon which is the vibration frequency of the electrification consistency in a metal will arise. This phenomenon is called surface plasmon resonance (SPR:Surface Plasmon Resonance).
[0003] Here, it is the wave number ke of an evanescent wave. It is expressed like a formula (1).
[0004]
[Equation 1]

$$k_e = k_p \sin\theta = \frac{2\pi}{\lambda}\sin\theta \qquad (1)$$

[0005] Moreover, the wave number ksp of a plasmon wave is expressed like a formula (2).
[0006]
[Equation 2]

$$k_{sp} = \frac{\omega}{c}\sqrt{\frac{\varepsilon n^2}{\varepsilon + n^2}} \qquad (2)$$

[0007] Here, angular frequency and c of omega are the refractive indexes of the medium by which the speed of light and epsilon are in contact of a metaled dielectric constant, and n is in contact with the metal. The wave number ke of an evanescent wave When the wave number ksp of a plasmon wave is in agreement, the evanescent wave of the light which carries out incidence excites plasmon (SPR), luminous energy decreases, and a reflected wave decreases. And since this plasmon (SPR) is influenced only by the medium on the front face of a metal membrane which is in near very much, if concentration change of a medium etc. breaks out very near the metal thin film, this will be reflected in a refractive

index and this will decrease the reinforcement of a reflected wave. Therefore, if optical loss and the correlation of a refractive index are beforehand made into known, the refractive index of a device under test can be measured.
[0008] As a conventional sensor based on the principle of such a surface plasmon phenomenon, there is a thing as shown in drawing 7 - drawing 9 . The approach shown in drawing 7 prepares a metal thin film in the rear face of flat-surface glass, is contacted in an inspected sample, carries out incidence of the light at the include angle theta in glass, and searches for the conditions of plasmon resonance. Moreover, the approach shown in drawing 8 and drawing 9 uses the metal thin film prepared in the light and the optical fiber front face in an optical fiber. It is not necessary to carry out the sample of the sample like [if it is the configuration shown in this drawing 7 and drawing 8] the sensor shown in drawing 7 , and if a sensor is contacted into an inspected sample, there is an advantage that measurement is possible. Moreover, as other approaches in connection with this drawing 8 and drawing 9 , a core is shifted from the medial axis of an optical fiber, and there is also a method of preparing a core near the outside interface of a clad.
[0009]
[Problem(s) to be Solved by the Invention] However, there are the following problems in the conventional sensor using such a surface plasmon phenomenon. First, in the sensor shown in drawing 7 , there is a problem that it is necessary to carry in the sample for inspected to the Banking Inspection Department. therefore, the measurement of the sample of the part which cannot inspect within an actual environment, for example, cannot carry out [inside / of a reactor] a sample as a matter of fact which must collect separately for inspection of a sample, and cannot inspect immediately when a device under test with a difficult inspection is in remoteness by few samples is impossible -- etc. -- there is a problem. Moreover, there is also a problem that inspection with the gestalt of monitoring the measuring object-ed continuously in the real time cannot be performed. Furthermore, in the sensor shown in drawing 7 , the optical system which consists of the light source and a photodetector must be constituted separately, equipment is complicated, and becomes large-scale, and there is also a problem that there is a limitation in the miniaturization of sensor equipment.
[0010] Moreover, by the approach shown in drawing 8 and drawing 9 , the cladding layer in an optical fiber is removed, the core section is shown, the complicated and precise special processing process of coating a metal thin film further is needed, and there is a problem that manufacture is difficult. Moreover, thereby, there is a problem of spoiling the mechanical strength of an optical fiber. Moreover, in constituting the sensor of such a gestalt, there is a request of wanting to use the optical fiber for transmission which has usually spread, but since such special processing is needed, there is also a problem that the optical fiber which has usually spread cannot be used. Moreover, there are a problem mentioned above and same problem in [which is not illustrated] that it is necessary to manufacture a special optical fiber also in the approach of shifting and preparing a core from the medial axis of an optical fiber.
[0011] Therefore, the purpose of this invention is easy to manufacture with an easy configuration, and is to offer the refractive-index sensor which can measure the refractive index of a desired sample easily and correctly. Moreover, other purposes of this invention are easy to manufacture with an easy configuration, measure the refractive index of a desired sample easily and correctly, and are to offer the sensor system which can detect appropriately physical quantity, the amount of chemistry, or a phenomenon in connection with the sample etc. by this. Other purposes of this invention are still easier to manufacture with an easy configuration, and it is in offering the optical fiber for optical transmissions which has the refractive-index sensor part which can measure the refractive index of a desired sample easily and correctly.
[0012]
[Means for Solving the Problem] In order to solve said technical problem, the refractive-index sensor concerning this invention It has a core and a clad and the 1st [which transmits the light which carried out incidence], and 2nd optical transmission sections, and said core of the 1st and the 2nd [said] optical transmission section have the core from which a path differs. Between said 1st optical

transmission section and said 2nd optical transmission section The perimeter of the hetero core section prepared so that the core and said core of each optical transmission section concerned might join, and said hetero core section is covered, and it has the metal thin film with which the exterior is contacted by the sample. In addition, a core is not concerned with the existence of a clad in this invention, but the thing of the configuration section mainly spread by the light by which incidence was carried out is put, the refractive index of a clad is more slightly [than a core] low, and the configuration section formed so that total reflection of the light by which incore is spread might be carried out substantially and a core might be surrounded is said.

[0013] Specifically, the terrorism core section has to the above the clad which covers a core with a path smaller than the path of said 1st optical transmission section and said 2nd optical transmission section, and the core concerned, and said metal thin film is formed in the front face of said clad of the terrorism core section to the above.

[0014] Moreover, specifically, said hetero core section has a core with a larger path than the path of the core of said 1st optical transmission section and said 2nd optical transmission section, and said metal thin film is formed in the front face of the core concerned so that said core of the terrorism core section may be covered to the above. That is, although it becomes the configuration of passing in this configuration, and, as for the terrorism core section, the direct metal thin film being prepared in the core, and not having a clad, the core said here needs to say the configuration section mainly spread by light, as mentioned above, and does not necessarily need to be the ingredient as the core of the 1st and 2nd optical transmission lines with that same ingredient. That is, this configuration means that it is not the dual structure of a core and a clad but the single structure of a certain optical propagation member.

[0015] Moreover, the light source which the sensor system in connection with this invention emits a predetermined light, and carries out incidence to said refractive-index sensor according to claim 1 to 5 through the optical transmission means of arbitration, The refractive-index sensor by which it is said refractive-index sensor by which incidence of the light by which from was carried out [aforementioned] is carried out, and it is passed, and said metal thin film is contacted by the sample for [desired] inspected, Incidence of the light which passed said refractive-index sensor is carried out, it detects the predetermined property of the light concerned by which incidence was carried out, and has property detection equipment which detects the physical quantity, the predetermined amount of chemistry, or predetermined phenomenon in connection with said sample based on the detection result of the property concerned.

[0016] Moreover, other sensor systems in connection with this invention The hetero core section prepared so that the optical fiber which transmits the light which carried out incidence, and the core of said optical fiber might have the core from which a path differs and said the 1st core and said core of an optical fiber might join them, The refractive-index sensor which has the metal thin film with which covers the perimeter of said hetero core section and the exterior is contacted by the sample, The light source which emits a predetermined light and carries out incidence of the light which this **(ed) to the optical fiber concerned from an edge opposite to the edge to which the core of said refractive-index sensor of said optical fiber is joined, It has property detection equipment which detects the predetermined property of the back scattered light of said light which carried out incidence by which outgoing radiation is carried out, and detects the physical quantity, the predetermined amount of chemistry, or predetermined phenomenon of said sample based on the detection result of the property concerned from the edge which carried out incidence of said light of said optical fiber.

[0017] Moreover, the optical fiber in connection with this invention has a core with a path smaller than the core of the 1st [which transmits the light which carried out incidence], and 2nd optical fiber sections, and said 1st optical fiber section and 2nd optical fiber section, and has the hetero core section fastened between said 1st optical fiber section and the 2nd optical fiber section, and the metal thin film which covered the perimeter of said hetero core section.

[0018] Moreover, an optical fiber says the thing of the optical transmission track formed so that it might have a core and a clad and they might be substantially spread without a loss [****] by the light by which incidence was carried out.

[0019]
[Embodiment of the Invention] The refractometry system of the gestalt of 1 operation of this invention is explained with reference to drawing 1 and drawing 2 . Drawing 1 is drawing showing the refractometry structure of a system of the gestalt of this operation. The refractometry system 1 has the plasmon resonance sensor 10, an optical fiber (transmission fiber) 20, the light source 30, and a spectrum analyzer 40.
[0020] First, the configuration of each part is explained. The light source 30 emits light and carries out incidence of the desired light to the plasmon resonance sensor 10 through an optical fiber 11. In the gestalt of this operation, the light source 30 shall emit light in the light of the white containing the light of all wavelength.
[0021] The 1st optical fiber equivalent to the 1st optical transmission section of a claim which transmits the light by which the optical fiber 20 was emitted by the light source 30 to the plasmon resonance sensor 10, and the 1st optical fiber section, Transmit the light which passed the plasmon resonance sensor 10 to a spectrum analyzer 40. It has the 2nd optical fiber equivalent to the 2nd optical transmission section of a claim, and the 2nd optical fiber section, and the plasmon resonance sensor 10 is passed and incidence of the light discharged by the light source 30 is carried out to a spectrum analyzer 40. This optical fiber 20 is an optical fiber for transmission which has usually spread, and is a multi-mode fiber with a core diameter of 50 micrometers.
[0022] The plasmon resonance sensor 10 is contacted by the sample to be examined, is a sensor part which measures the refractive index of the sample, and decreases the optical reinforcement of the light of the predetermined incident angle based on the property of a sample according to a surface plasmon resonance phenomenon to the light inputted through the optical fiber 20 (11). It is drawing showing the configuration of the plasmon resonance sensor 10 in drawing 2 . As shown in drawing 2 , the plasmon resonance sensor 10 has an optical fiber (transmission fiber) 11, the hetero core section 14, and the metal thin film 17. In addition, an optical fiber 11 has a core 12 and a clad 13, and the hetero core section 14 has a core 15 and a clad 16.
[0023] An optical fiber 11 transmits the light emitted by the light source 30, and it carries out incidence to the hetero core section 14. Moreover, the light which passed the hetero core section 14 is transmitted to a spectrum analyzer 40. In addition, the optical fiber 11 is the same as the optical fiber 20 shown in drawing 1 , and equivalent to the edge.
[0024] The hetero core section 14 welds and prepares the optical fiber which has the core 15 with a small enough path between optical fibers 11 from the core 12 of an optical fiber 11. In the gestalt of this operation, the path of the core 15 of the hetero core section 14 is 3 micrometers, and the die length of the hetero core section 14 is several cm from several mm.
[0025] A metal thin film is a metallic film by which coating was carried out by the approach of arbitration, as the hetero core section 14 is covered, and it is a thin film of gold or silver in the gestalt of this operation.
[0026] A spectrum analyzer 40 displays the spectrum distribution of the light by which incidence was carried out through the optical fiber 11 in the condition that the optical reinforcement of each wavelength is observable. Thereby, an operating personnel can observe the wavelength of the decreased light and can know the refractive index of the sample which the plasmon resonance sensor 10 touches by referring to correlation with the refractive index obtained beforehand.
[0027] Next, actuation of the refractometry system 1 of such a configuration is explained. The light emitted by the light source 30 is transmitted in the inside of the optical fiber 20 of a big core diameter (11), and incidence is carried out to the hetero core section 14 of the plasmon resonance sensor 10. If incidence of the light is carried out to the hetero core section 14, in breadth and the clad section 16, reflection of light will come to be performed for an amount with a considerable light transmitted in the core 12 of an optical fiber 11 in the clad section 16 of the hetero core section 14 outside a fiber as cladding mode in an interface 19.
[0028] Since the metal thin film 17 is formed in the interface 19 outside a clad, the surface plasmon phenomenon which this described previously will be excited. Consequently, it would be affected by the

ambient atmosphere of the front face of the metal thin film 17, namely, the light of a predetermined incident angle depending on the property of a sample will be used for excitation of a surface plasmon phenomenon, and luminous intensity decreases. Though it is made such and specific luminous intensity decreases, incidence of the light by which incidence was carried out to the hetero core section 14 is again carried out to an optical fiber 11. That is, the spectrum by surface plasmon resonance (SPR) is reflected in the optical reinforcement in the transmission optical fiber 11 of the hetero core section 14 latter part.

[0029] And in a spectrum analyzer 40, it asks for the degree of loss to wavelength in the light by which incidence was carried out, and asks for a refractive index from this. In an optical fiber, the light transmitted can consider carrying out incidence at an angle of plurality towards an outside from the clad inside. Although this is because two or more cladding modes within a clad exist, since the difference in the include angle by the mode has distribution focusing on a certain include angle, the breadth of an include angle is not so large. Then, if installation conditions, such as curvature of an optical fiber, are fixed and correlation of the degree of loss and a refractive index over wavelength is clarified, a refractive index will be measured from the loss over the wavelength.

[0030] Thus, a metal thin film is given to the sensor of a hetero core fabric, and he produces and cheats out of a surface plasmon mesomeric effect, and is trying to measure a refractive index in the refractometry equipment 1 of the gestalt of this operation from loss of the transmission light in an optical fiber, and the correlation between the refractive indexes of a device under test. Therefore, the refractive index of the sample can be easily measured only by contacting the sample of a request of a liquid and a gas to the metal thin film 17 of the plasmon resonance sensor 10. That is, measurement of the refractive index of a sample is attained, without carrying out the sample of the measuring object-ed.

[0031] Moreover, it can weld the optical fiber with which a core diameter is different in the middle of a transmission optical fiber, and the structure of the plasmon resonance sensor 10 is very easy only by what is necessary being just to coat the perimeter with a metal thin film, and the core of the conventional optical fiber can be exposed or it can manufacture it easily compared with processes, such as shifting a core. Moreover, since the light for measurement should just also only carry out incidence of the light to an optical fiber, it can use the existing light source and the configuration of optical system can also simplify it.

[0032] In addition, this invention is not restricted to the gestalt of this operation, and arbitrary suitable various modification is possible for it. For example, you may make it use the fiber which has the larger core 18 than the path of the core 12 of the transmission fiber 11 for the hetero core section, as the configuration of a plasmon resonance sensor is not restricted to the configuration shown in drawing 2 , either and is shown in drawing 3 . In the configuration illustrated to drawing 3 , an optical transmission member without the clad which consists of a core 18 substantially is used as the hetero core section. Also in plasmon resonance sensor 10b of such a configuration, it will spread throughout a core 18, a plasmon resonance phenomenon arises like the plasmon resonance sensor 10 shown in drawing 2 , and the light transmitted in the core 12 of the transmission fiber 11 can acquire the same effectiveness.

[0033] Moreover, what is necessary is not to restrict the die length of the hetero core section 14 of the plasmon resonance sensor 10, the paths of a core 15, and those combination to the gestalt of this operation, and just to choose them as arbitration so that environmental influence can be received in extent suitable for measurement.

[0034] Moreover, in the gestalt of this operation, although it asked for the refractive index from loss of the wavelength which shows attenuation using the source of the white light, and a spectrum analyzer, if the light source 30 emits a monochromatic light, for example, since a refractive index will have the magnitude of attenuation of the light at that time, and correlation, a refractive index can be measured from the magnitude of attenuation of light. It is good also as such a configuration.

[0035] Moreover, an optical fiber does not need to be a multimode and a single mode fiber is sufficient as it. Moreover, the device which measures the spectrum and reinforcement of light is not restricted to a spectrum analyzer, and is good with the equipment of arbitration.

[0036] Moreover, this invention is OTDR (Optical Time Domain Reflectometry: time-sharing light

reflex measurement). By using law, it can carry out also by the systems 1b and 1c as shown in drawing 4 . In addition, OTDR can carry out incidence of the light pulses, such as a laser beam, to an optical fiber, time amount decomposition of it can be carried out, it can measure the back scattered light which returns from the middle of optical transmission to an incidence side (back), and can measure the information on the location of the arbitration of an optical transmission line in the real time. In the system shown in drawing 4 (A), incidence of the light of the wavelength which produces a plasmon phenomenon using OTDR equipment 50 is carried out to an optical fiber 20, and the back scattered light (the Rey Gee dispersion) is measured. Since this back scattered light also changes according to attenuation of the light of the sensor section (hetero core section 10), the optical reinforcement which OTDR measures will change with refractive indexes, and can know a refractive index by measuring optical reinforcement substantially.
[0037] In addition, it is the system which detects such a backscattering angle, and as long as it detects the light which backscatters in the hetero core section and measures a refractive index, you may make it use an optical fiber for measurement which uses the hetero core section as termination substantially, as shown in drawing 4 (B). Such a configuration is also within the limits of this invention.
[0038] Moreover, in the gestalt of this operation, although the refractometry system was illustrated and this invention was explained, this invention is applicable to the other various systems. For example, the various physical quantity depending on a refractive index, the amount of chemistry or a phenomenon, a condition, etc. are applicable to the equipment detected or observed. It is applicable to the sensor system which specifically detects the class of the acidity depending on a refractive index, the concentration of various matter, the consistency of various matter, a liquid, and gas etc. Moreover, it is applicable also to sensor systems, such as inspection of the condition of inspection of a condition in the living body, a reactor, etc., for example. Moreover, the detection and the quantum of a component which are contained in a liquid, a gas, and a solid-state are also possible. Moreover, the biosensor which measures protein concentration also becomes possible.
[0039] in addition, each sensor system of these specified uses as equipment of the latter part which measured the refractive index of a sample by configuration like the gestalt of this operation or as equipment which detects the light which passed the plasmon resonance sensor and receives light directly What is necessary is just to form the signal processor which should say the property of plasmon resonance sensor passage light also as the property detection equipment for making it correspond to the physical quantity for these detection, the amount of chemistry, a phenomenon, a condition, etc., and it is clear that these systems are also within the limits of this invention.
[0040] Moreover, as shown in drawing 5 , the network sensing system which can observe the physical quantity, the amount of chemistry, or phenomenon of a multipoint in concurrency in the real time can be constituted by preparing many optical fibers which have a plasmon resonance sensor as shown in drawing 1 . Since the sensor in connection with this invention can be treated like the usual optical fiber, it can build the sensing system of such a configuration easily.
[0041]
[Effect of the Invention] Thus, according to this invention, manufacture is easy with an easy configuration and the refractive-index sensor which can measure the refractive index of a desired sample easily and correctly can be offered. Moreover, manufacture can be easy with an easy configuration, the refractive index of a desired sample can be measured easily and correctly, and the sensor system which can detect appropriately physical quantity, the amount of chemistry, or a phenomenon in connection with the sample etc. by this can be offered. Furthermore, manufacture is easy with an easy configuration and the optical fiber for optical transmissions which has the refractive-index sensor part which can measure the refractive index of a desired sample easily and correctly can be offered.

[Translation done.]

* NOTICES *

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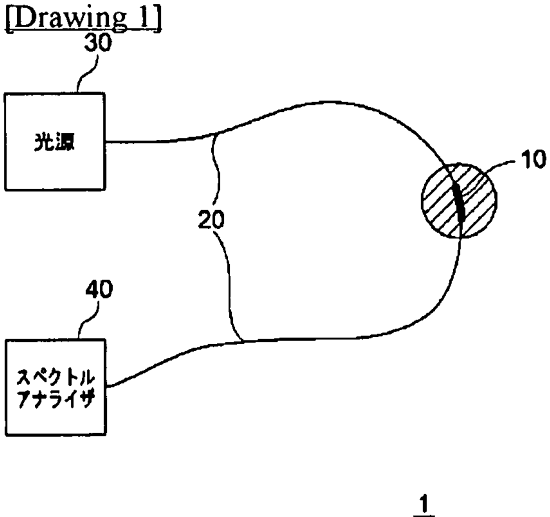
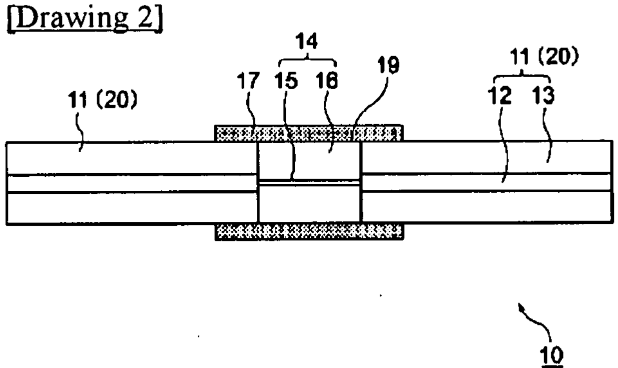
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

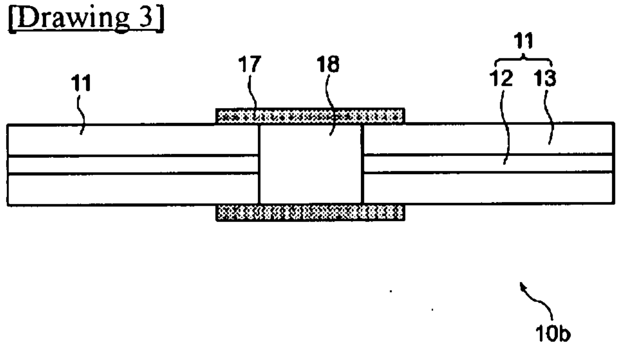
[Drawing 1]



[Drawing 2]

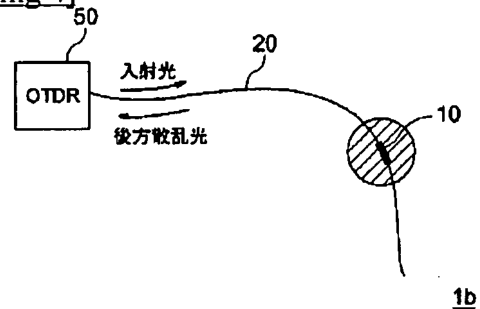


[Drawing 3]



[Drawing 4]

(A)



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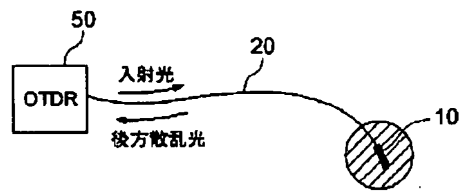
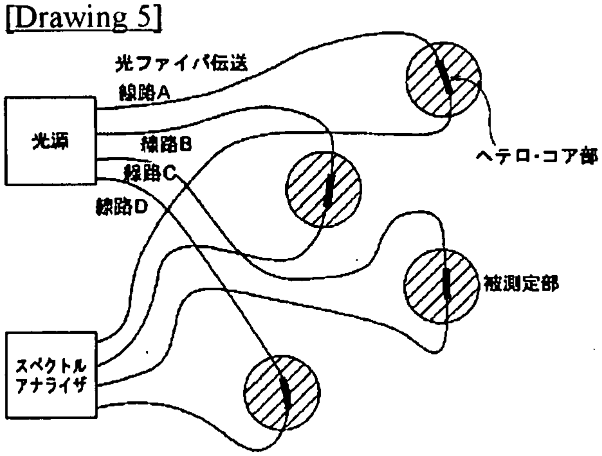
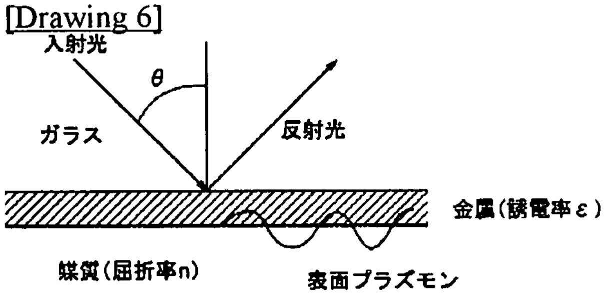


1c

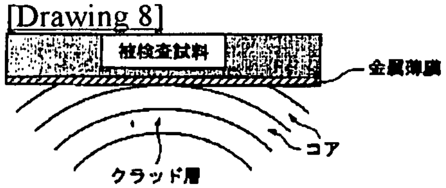
[Drawing 5]



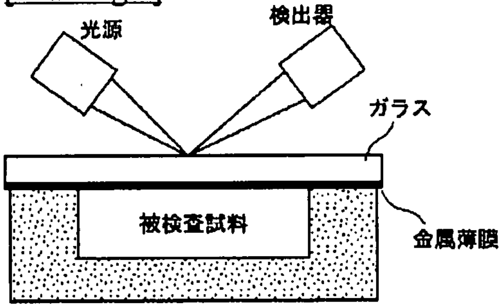
[Drawing 6]



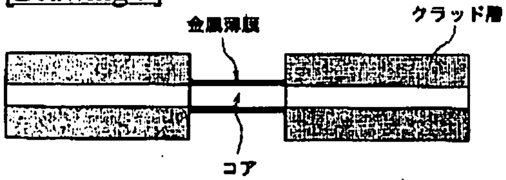
[Drawing 8]



[Drawing 7]



[Drawing 9]



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CLAIMS

[Claim(s)]
[Claim 1] It has a core and a clad and the 1st [which transmits the light which carried out incidence], and 2nd optical transmission sections, and said core of the 1st and the 2nd [said] optical transmission section have the core from which a path differs. Between said 1st optical transmission section and said 2nd optical transmission section The refractive-index sensor which has the hetero core section prepared so that the core and said core of each optical transmission section concerned might join, and the metal thin film with which cover the perimeter of said hetero core section and the exterior is contacted by the sample.
[Claim 2] It is the refractive-index sensor according to claim 1 by which the terrorism core section has to the above the clad which covers a core with a path smaller than the path of said 1st optical transmission section and said 2nd optical transmission section, and the core concerned, and said metal thin film was formed in the front face of said clad of the terrorism core section to the above.
[Claim 3] It is the refractive-index sensor according to claim 2 whose core diameter of the terrorism core section the core diameter of said 1st and 2nd optical transmission sections is about 50 micrometers, and is about 3 micrometers in the above.
[Claim 4] It is the refractive-index sensor according to claim 1 to 3 by which all the terrorism core all [any one, plurality, or] consist of optical fibers to said 1st optical transmission section, the 2nd [said] optical transmission section, and the above.
[Claim 5] It is the refractive-index sensor according to claim 1 which said hetero core section has a core with a larger path than the path of the core of said 1st optical transmission section and said 2nd optical transmission section, and was formed in the front face of the core concerned so that said metal thin film might cover said core of the terrorism core section to the above.
[Claim 6] It is a refractive-index sensor to a publication in either of claims 1-5 to which the terrorism core section is considered as the 1st optical transmission section to said above, and welding of both the terrorism core section, and said the 2nd optical transmission both [either or] is carried out respectively to the above.
[Claim 7] The light source which emits a predetermined light and carries out incidence to said refractive-index sensor according to claim 1 to 5 through the optical transmission means of arbitration, The refractive-index sensor by which it is said refractive-index sensor by which incidence of the light by which from was carried out [aforementioned] is carried out, and it is passed, and said metal thin film is contacted by the sample for [desired] inspected, The sensor system which has property detection equipment which incidence of the light which passed said refractive-index sensor is carried out, detects the predetermined property of the light concerned by which incidence was carried out, and detects the physical quantity, the predetermined amount of chemistry, or predetermined phenomenon in connection with said sample based on the detection result of the property concerned.
[Claim 8] It is the sensor system according to claim 7 which said light source emits the light which has the light of two or more wavelength, carries out incidence to said refractive-index sensor, and detects the wavelength and/or the magnitude of attenuation which are decreasing said property detection equipment

about the light which passed said said refractive-index sensor by which incidence was carried out.
[Claim 9] It is the sensor system according to claim 7 by which said light source emits the light of single wavelength, it carries out incidence to said refractive-index sensor, and said property detection equipment detects the magnitude of attenuation of light about said light which passed said said refractive-index sensor by which incidence was carried out.
[Claim 10] Said property detection equipment is a sensor system according to claim 7 to 9 which detects the refractive index of said sample based on said detection result.
[Claim 11] Said property detection equipment is a sensor system according to claim 10 which detects the refractive index of said sample based on said detection result, and detects either the concentration of the acidity of said sample, a class, and the predetermined matter, or the consistency of the predetermined matter based on the refractive index concerned.
[Claim 12] Said refractive-index sensor and said property detection equipment at least are a sensor system according to claim 7 to 11 which performs detection of said predetermined physical quantity, the amount of chemistry, or a phenomenon to the sample in the part which is connected by the optical fiber and isolated substantially.
[Claim 13] It is the sensor system according to claim 7 to 12 which it has said two or more refractive-index sensors, and said light source carries out incidence of said light to said two or more refractive-index sensors, and performs detection of said predetermined physical quantity, the amount of chemistry, or a phenomenon about said two or more samples to which said property detection equipment is equivalent to two or more refractive-index sensors concerned based on the light which carried out incidence from said two or more refractive-index sensors of each.
[Claim 14] The hetero core section prepared so that the optical fiber which transmits the light which carried out incidence, and the core of said optical fiber might have the core from which a path differs and said the 1st core and said core of an optical fiber might join them, The refractive-index sensor which has the metal thin film with which covers the perimeter of said hetero core section and the exterior is contacted by the sample, The light source which emits a predetermined light and carries out incidence of the light which this **(ed) to the optical fiber concerned from an edge opposite to the edge to which the core of said refractive-index sensor of said optical fiber is joined, The sensor system which has property detection equipment by which outgoing radiation is carried out from the edge which carried out incidence of said light of said optical fiber, and which detects the predetermined property of the back scattered light of said light which carried out incidence, and detects the physical quantity, the predetermined amount of chemistry, or predetermined phenomenon in connection with said sample based on the detection result of the property concerned.
[Claim 15] The optical fiber which has a core with a path smaller than the core of the 1st [which transmits the light which carried out incidence], and 2nd optical fiber sections, and said 1st optical fiber section and 2nd optical fiber section, and has the metal thin film which covered the perimeter of the 3rd optical fiber section fastened between said 1st optical fiber section and the 2nd optical fiber section, and said 3rd optical fiber section.

[Translation done.]